

## FILTERING NETWORK MANAGEMENT MESSAGES

[illegible][illegible]

BACKGROUND OF THE INVENTION

In communication systems, network management systems configure and monitor various network elements using management messages in various protocols such as transaction language 1 (TL1) or simple network management protocol  
5 (SNMP). For example, using management messages, a network management system can set up and monitor network elements, such as line cards in a SONET network element. With the dramatic increases in the number of network elements requiring management, network management systems must frequently handle vast quantities of information relating to managed network elements.

01  
02  
03  
04  
05  
06  
07  
08  
09  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65  
66  
67  
68  
69  
70  
71  
72  
73  
74  
75  
76  
77  
78  
79  
80  
81  
82  
83  
84  
85  
86  
87  
88  
89  
90  
91  
92  
93  
94  
95  
96  
97  
98  
99  
100  
101  
102  
103  
104  
105  
106  
107  
108  
109  
110  
111  
112  
113  
114  
115  
116  
117  
118  
119  
120  
121  
122  
123  
124  
125  
126  
127  
128  
129  
130  
131  
132  
133  
134  
135  
136  
137  
138  
139  
140  
141  
142  
143  
144  
145  
146  
147  
148  
149  
150  
151  
152  
153  
154  
155  
156  
157  
158  
159  
160  
161  
162  
163  
164  
165  
166  
167  
168  
169  
170  
171  
172  
173  
174  
175  
176  
177  
178  
179  
180  
181  
182  
183  
184  
185  
186  
187  
188  
189  
190  
191  
192  
193  
194  
195  
196  
197  
198  
199  
200  
201  
202  
203  
204  
205  
206  
207  
208  
209  
210  
211  
212  
213  
214  
215  
216  
217  
218  
219  
220  
221  
222  
223  
224  
225  
226  
227  
228  
229  
230  
231  
232  
233  
234  
235  
236  
237  
238  
239  
240  
241  
242  
243  
244  
245  
246  
247  
248  
249  
250  
251  
252  
253  
254  
255  
256  
257  
258  
259  
260  
261  
262  
263  
264  
265  
266  
267  
268  
269  
270  
271  
272  
273  
274  
275  
276  
277  
278  
279  
280  
281  
282  
283  
284  
285  
286  
287  
288  
289  
290  
291  
292  
293  
294  
295  
296  
297  
298  
299  
300  
301  
302  
303  
304  
305  
306  
307  
308  
309  
310  
311  
312  
313  
314  
315  
316  
317  
318  
319  
320  
321  
322  
323  
324  
325  
326  
327  
328  
329  
330  
331  
332  
333  
334  
335  
336  
337  
338  
339  
340  
341  
342  
343  
344  
345  
346  
347  
348  
349  
350  
351  
352  
353  
354  
355  
356  
357  
358  
359  
360  
361  
362  
363  
364  
365  
366  
367  
368  
369  
370  
371  
372  
373  
374  
375  
376  
377  
378  
379  
380  
381  
382  
383  
384  
385  
386  
387  
388  
389  
390  
391  
392  
393  
394  
395  
396  
397  
398  
399  
400  
401  
402  
403  
404  
405  
406  
407  
408  
409  
410  
411  
412  
413  
414  
415  
416  
417  
418  
419  
420  
421  
422  
423  
424  
425  
426  
427  
428  
429  
430  
431  
432  
433  
434  
435  
436  
437  
438  
439  
440  
441  
442  
443  
444  
445  
446  
447  
448  
449  
450  
451  
452  
453  
454  
455  
456  
457  
458  
459  
460  
461  
462  
463  
464  
465  
466  
467  
468  
469  
470  
471  
472  
473  
474  
475  
476  
477  
478  
479  
480  
481  
482  
483  
484  
485  
486  
487  
488  
489  
490  
491  
492  
493  
494  
495  
496  
497  
498  
499  
500  
501  
502  
503  
504  
505  
506  
507  
508  
509  
510  
511  
512  
513  
514  
515  
516  
517  
518  
519  
520  
521  
522  
523  
524  
525  
526  
527  
528  
529  
530  
531  
532  
533  
534  
535  
536  
537  
538  
539  
540  
541  
542  
543  
544  
545  
546  
547  
548  
549  
550  
551  
552  
553  
554  
555  
556  
557  
558  
559  
560  
561  
562  
563  
564  
565  
566  
567  
568  
569  
570  
571  
572  
573  
574  
575  
576  
577  
578  
579  
580  
581  
582  
583  
584  
585  
586  
587  
588  
589  
590  
591  
592  
593  
594  
595  
596  
597  
598  
599  
600  
601  
602  
603  
604  
605  
606  
607  
608  
609  
610  
611  
612  
613  
614  
615  
616  
617  
618  
619  
620  
621  
622  
623  
624  
625  
626  
627  
628  
629  
630  
631  
632  
633  
634  
635  
636  
637  
638  
639  
640  
641  
642  
643  
644  
645  
646  
647  
648  
649  
650  
651  
652  
653  
654  
655  
656  
657  
658  
659  
660  
661  
662  
663  
664  
665  
666  
667  
668  
669  
670  
671  
672  
673  
674  
675  
676  
677  
678  
679  
680  
681  
682  
683  
684  
685  
686  
687  
688  
689  
690  
691  
692  
693  
694  
695  
696  
697  
698  
699  
700  
701  
702  
703  
704  
705  
706  
707  
708  
709  
710  
711  
712  
713  
714  
715  
716  
717  
718  
719  
720  
721  
722  
723  
724  
725  
726  
727  
728  
729  
730  
731  
732  
733  
734  
735  
736  
737  
738  
739  
740  
741  
742  
743  
744  
745  
746  
747  
748  
749  
750  
751  
752  
753  
754  
755  
756  
757  
758  
759  
760  
761  
762  
763  
764  
765  
766  
767  
768  
769  
770  
771  
772  
773  
774  
775  
776  
777  
778  
779  
780  
781  
782  
783  
784  
785  
786  
787  
788  
789  
790  
791  
792  
793  
794  
795  
796  
797  
798  
799  
800  
801  
802  
803  
804  
805  
806  
807  
808  
809  
810  
811  
812  
813  
814  
815  
816  
817  
818  
819  
820  
821  
822  
823  
824  
825  
826  
827  
828  
829  
830  
831  
832  
833  
834  
835  
836  
837  
838  
839  
840  
841  
842  
843  
844  
845  
846  
847  
848  
849  
850  
851  
852  
853  
854  
855  
856  
857  
858  
859  
860  
861  
862  
863  
864  
865  
866  
867  
868  
869  
870  
871  
872  
873  
874  
875  
876  
877  
878  
879  
880  
881  
882  
883  
884  
885  
886  
887  
888  
889  
890  
891  
892  
893  
894  
895  
896  
897  
898  
899  
900  
901  
902  
903  
904  
905  
906  
907  
908  
909  
910  
911  
912  
913  
914  
915  
916  
917  
918  
919  
920  
921  
922  
923  
924  
925  
926  
927  
928  
929  
930  
931  
932  
933  
934  
935  
936  
937  
938  
939  
940  
941  
942  
943  
944  
945  
946  
947  
948  
949  
950  
951  
952  
953  
954  
955  
956  
957  
958  
959  
960  
961  
962  
963  
964  
965  
966  
967  
968  
969  
970  
971  
972  
973  
974  
975  
976  
977  
978  
979  
980  
981  
982  
983  
984  
985  
986  
987  
988  
989  
990  
991  
992  
993  
994  
995  
996  
997  
998  
999  
1000  
1001  
1002  
1003  
1004  
1005  
1006  
1007  
1008  
1009  
1010  
1011  
1012  
1013  
1014  
1015  
1016  
1017  
1018  
1019  
1020  
1021  
1022  
1023  
1024  
1025  
1026  
1027  
1028  
1029  
1030  
1031  
1032  
1033  
1034  
1035  
1036  
1037  
1038  
1039  
1040  
1041  
1042  
1043  
1044  
1045  
1046  
1047  
1048  
1049  
1050  
1051  
1052  
1053  
1054  
1055  
1056  
1057  
1058  
1059  
1060  
1061  
1062  
1063  
1064  
1065  
1066  
1067  
1068  
1069  
1070  
1071  
1072  
1073  
1074  
1075  
1076  
1077  
1078  
1079  
1080  
1081  
1082  
1083  
1084  
1085  
1086  
1087  
1088  
1089  
1090  
1091  
1092  
1093  
1094  
1095  
1096  
1097  
1098  
1099  
1100  
1101  
1102  
1103  
1104  
1105  
1106  
1107  
1108  
1109  
1110  
1111  
1112  
1113  
1114  
1115  
1116  
1117  
1118  
1119  
1120  
1121  
1122  
1123  
1124  
1125  
1126  
1127  
1128  
1129  
1130  
1131  
1132  
1133  
1134  
1135  
1136  
1137  
1138  
1139  
1140  
1141  
1142  
1143  
1144  
1145  
1146  
1147  
1148  
1149  
1150  
1151  
1152  
1153  
1154  
1155  
1156  
1157  
1158  
1159  
1160  
1161  
1162  
1163  
1164  
1165  
1166  
1167  
1168  
1169  
1170  
1171  
1172  
1173  
1174  
1175  
1176  
1177  
1178  
1179  
1180  
1181  
1182  
1183  
1184  
1185  
1186  
1187  
1188  
1189  
1190  
1191  
1192  
1193  
1194  
1195  
1196  
1197  
1198  
1199  
1200  
1201  
1202  
1203  
1204  
1205  
1206  
1207  
1208  
1209  
1210  
1211  
1212  
1213  
1214  
1215  
1216  
1217  
1218  
1219  
1220  
1221  
1222  
1223  
1224  
1225  
1226  
1227  
1228  
1229  
1230  
1231  
1232  
1233  
1234  
1235  
1236  
1237  
1238  
1239  
1240  
1241  
1242  
1243  
1244  
1245  
1246  
1247  
1248  
1249  
1250  
1251  
1252  
1253  
1254  
1255  
1256  
1257  
1258  
1259  
1260  
1261  
1262  
1263  
1264  
1265  
1266  
1267  
1268  
1269  
1270  
1271  
1272  
1273  
1274  
1275  
1276  
1277  
1278  
1279  
1280  
1281  
1282  
1283  
1284  
1285  
1286  
1287  
1288  
1289  
1290  
1291  
1292  
1293  
1294  
1295  
1296  
1297  
1298  
1299  
1300  
1301  
1302  
1303  
1304  
1305  
1306  
1307  
1308  
1309  
1310  
1311  
1312  
1313  
1314  
1315  
1316  
1317  
1318  
1319  
1320  
1321  
1322  
1323  
1324  
1325  
1326  
1327  
1328  
1329  
1330  
1331  
1332  
1333  
1334  
1335  
1336  
1337  
1338  
1339  
1340  
1341  
1342  
1343  
1344  
1345  
1346  
1347  
1348  
1349  
1350  
1351  
1352  
1353  
1354  
1355  
1356  
1357  
1358  
1359  
1360  
1361  
1362  
1363  
1364  
1365  
1366  
1367  
1368  
1369  
1370  
1371  
1372  
1373  
1374  
1375  
1376  
1377  
1378  
1379  
1380  
1381  
1382  
1383  
1384  
1385  
1386  
1387  
1388  
1389  
1390  
1391  
1392  
1393  
1394  
1395  
1396  
1397  
1398  
1399  
1400  
1401  
1402  
1403  
1404  
1405  
1406  
1407  
1408  
1409  
1410  
1411  
1412  
1413  
1414  
1415  
1416  
1417  
1418  
1419  
1420  
1421  
1422  
1423  
1424  
1425  
1426  
1427  
1428  
1429  
1430  
1431  
1432  
1433  
1434  
1435  
1436  
1437  
1438  
1439  
1440  
1441  
1442  
1443  
1444  
1445  
1446  
1447  
1448  
1449  
1450  
1451  
1452  
1453  
1454  
1455  
1456  
1457  
1458  
1459  
1460  
1461  
1462  
1463  
1464  
1465  
1466  
1467  
1468  
1469  
1470  
1471  
1472  
1473  
1474  
1475  
1476  
1477  
1478  
1479  
1480  
1481  
1482  
1483  
1484  
1485  
1486  
1487  
1488  
1489  
1490  
1491  
1492  
1493  
1494  
1495  
1496  
1497  
1498  
1499  
1500  
1501  
1502  
1503  
1504  
1505  
1506  
1507  
1508  
1509  
1510  
1511  
1512  
1513  
1514  
1515  
1516  
1517  
1518  
1519  
1520  
1521  
1522  
1523  
1524  
1525  
1526  
1527  
1528  
1529  
1530  
1531  
1532  
1533  
1534  
1535  
1536  
1537  
1538  
1539  
1540  
1541  
1542  
1543  
1544  
1545  
1546  
1547  
1548  
1549  
1550  
1551  
1552  
1553  
1554  
1555  
1556  
1557  
1558  
1559  
1560  
1561  
1562  
1563  
1564  
1565  
1566  
1567  
1568  
1569  
1570  
1571  
1572  
1573  
1574  
1575  
1576  
1577  
1578  
1579  
1580  
1581  
1582  
1583  
1584  
1585  
1586  
1587  
1588  
1589  
1590  
1591  
1592  
1593  
1594  
1595  
1596  
1597  
1598  
1599  
1600  
1601  
1602  
1603  
1604  
1605  
1606  
1607  
1608  
1609  
1610  
1611  
1612  
1613  
1614  
1615  
1616  
1617  
1618  
1619  
1620  
1621  
1622  
1623  
1624  
1625  
1626  
1627  
1628  
1629  
1630  
1631  
1632  
1633  
1634  
1635  
1636  
1637  
1638  
1639  
1640  
1641  
1642  
1643  
1644  
1645  
1646  
1647  
1648  
1649  
1650  
1651  
1652  
1653  
1654  
1655  
1656  
1657  
1658  
1659  
1660  
1661  
1662  
1663  
1664  
1665  
1666  
1667  
1668  
1669  
1670  
1671  
1672  
1673  
1674  
1675  
1676  
1677  
1678  
1679  
1680  
1681  
1682  
1683  
1684  
1685  
1686  
1687  
1688  
1689  
1690  
1691  
1692  
1693  
1694  
1695  
1696  
1697  
1698  
1699  
1700  
1701  
1702  
1703  
1704  
1705  
1706  
1707  
1708  
1709  
1710  
1711  
1712  
1713  
1714  
1715  
1716  
1717  
1718  
1719  
1720  
1721  
1722  
1723  
1724  
1725  
1726  
1727  
1728  
1729  
1730  
1731  
1732  
1733  
1734  
1735  
1736  
1737  
1738  
1739  
1740  
1741  
1742  
1743  
1744  
1745  
1746  
1747  
1748  
1749  
1750  
1751  
1752  
1753  
1754  
1755  
1756  
1757  
1758  
1759  
1760  
1761  
1762  
1763  
1764  
1765  
1766  
1767  
1768  
1769  
1770  
1771  
1772  
1773  
1774  
1775  
1776  
1777  
1778  
1779  
1780  
1781  
1782  
1783  
1784  
1785  
1786  
1787  
1788  
1789  
1790  
1791  
1792  
1793  
1794  
1795  
1796  
1797  
1798  
1799  
1800  
1801  
1802  
1803  
1804  
1805  
1806  
1807  
1808  
1809  
1810  
1811  
1812  
1813  
1814  
1815  
1816  
1817  
1818  
1819  
1820  
1821  
1822  
1823  
1824  
1825  
1826  
1827  
1828  
1829  
1830  
1831  
1832  
1833  
1834  
1835  
1836  
1837  
1838  
1839  
1840  
1841  
1842  
1843  
1844  
1845  
1846  
1847  
1848  
1849  
1850  
1851  
1852  
1853  
1854  
1855  
1856  
1857  
1858  
1859  
1860  
1861  
1862  
1863  
1864  
1865  
1866  
1867  
1868  
1869  
1870  
1871  
1872  
1873  
1874  
1875  
1876  
1877  
1878  
1879  
1880  
1881  
1882  
1883  
1884  
1885  
1886  
1887  
1888  
1889  
1890  
1891  
1892  
1893  
1894  
1895  
1896  
1897  
1898  
1899  
1900  
1901  
1902  
1903  
1904  
1905  
1906  
1907  
1908  
1909  
1910  
1911  
1912  
1913  
1914  
1915  
1916  
1917  
1918  
1919  
1920  
1921  
1922  
1923  
1924  
1925  
1926  
1927  
1928  
1929  
1930  
1931  
1932  
1933  
1934  
1935  
1936  
1937  
1938  
1939  
1940  
1941  
1942  
1943  
1944  
1945  
1946  
1947  
1948  
1949  
1950  
1951  
1952  
1953  
1954  
1955  
1956  
1957  
1958  
1959  
1960  
1961  
1962  
1963  
1964  
1965  
1966  
1967  
1968  
1969  
1970  
1971  
1972  
1973  
1974  
1975  
1976  
1977  
1978  
1979  
1980  
1981  
1982  
1983  
1984  
1985  
1986  
1987  
1988  
1989  
1990  
1991  
1992  
1993  
1994  
1995  
1996  
1997  
1998  
1999  
2000  
2001  
2002  
2003  
2004  
2005  
2006  
2007  
2008  
2009  
2010  
2011  
2012  
2013  
2014  
2015  
2016  
2017  
2018  
2019  
2020  
2021  
2022  
2023  
2024  
2025  
2026  
2027  
2028  
2029  
2030  
2031  
2032  
2033  
2034  
2035  
2036  
2037  
2038  
2039  
2040  
2041  
2042  
2043  
2044  
2045  
2046  
2047  
2048  
2049  
2050  
2051  
2052  
2053  
2054  
2055  
2056  
2057  
2058  
2059  
2060  
2061  
2062  
2063  
2064  
2065  
2066  
2067  
2068  
2069  
2070  
2071  
2072  
2073  
2074  
2075  
2076  
2077  
2078  
2079  
2080  
2081  
2082  
2083  
2084  
2085  
2086  
2087  
2088  
2089  
2090  
2091  
2092  
2093  
2094  
2095  
2096  
2097  
2098  
2099  
2100  
2101  
2102  
2103  
2104  
2105  
2106  
2107  
2108  
2109  
2110  
2111  
2112  
2113  
2114  
2115  
2116  
2117  
2118  
2119  
2120  
2121  
2122  
2123  
2124  
2125  
2126  
2127  
2128  
2129  
2130  
2131  
2132  
2133  
2134  
2135  
2136  
2137  
2138  
2139  
2140  
2141  
2142  
2143  
2144  
2145  
2146  
2147  
2148  
2149  
2150  
2151  
2152  
2153  
2154  
2155  
2156  
2157  
2158  
2159  
2160  
2161  
2162  
2163  
2164  
2165  
2166  
2167  
2168  
2169  
2170  
2171  
2172  
2173  
2174  
2175  
2176  
2177  
2178  
2179  
2180  
2181  
2182  
2183  
2184  
2185  
2186  
2187  
2188  
2189  
2190  
2191  
2192  
2193

SUMMARY OF THE INVENTION

In accordance with the present invention, techniques for filtering of network management messages are provided which substantially eliminate or reduce disadvantages and problems associated with previous techniques. In a particular embodiment, the present invention satisfies a need for a network management system that receives network management messages, parses these messages into their constituent fields, and, for each message, compares the values of the fields to filtering criteria established for any number of client consoles and communicates the fields of the message to those client consoles for which the values of the fields satisfy the filtering criteria.

In accordance with a particular embodiment of the present invention, a method for processing a network management message receives the network management message and parses the network management message into fields. The method then accesses filtering criteria for a number of client consoles. For each of the client consoles, if the fields satisfy the filtering criteria, the method communicates the fields to the client console for display by the client console.

Various embodiments of the present invention provide a number of technical advantages. However, embodiments may display some, all, or none of the various advantages detailed below. Using these techniques, a network management system effectively and efficiently presents real-time network management information to any number of display consoles based on filtering criteria established for each console. For a console, the filtering criteria may include a user type or access level for the console and specific values or types of values to compare against one or more of the fields of received messages. For example, the filtering criteria for a console may specify particular message types to display. However, by also permitting filtering based on user types, the network management system can implement security to limit access to network management information to only appropriate users. In addition, by allowing users to specify filtering criteria, the network management system presents only relevant information, as determined by a user, selected from real-time network management messages.

According to particular embodiments, consoles that display filtered network management messages to users permit user-defined ordering of displayed fields from

[illegible]

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention and its advantages, reference is now made to the following description, taken in conjunction with the accompanying drawings, in which:

5       FIGURE 1 illustrates a communication system having a network management server for parsing and filtering network management messages for communication of each message to selected consoles for display;

FIGURE 2 illustrates a console for displaying parsed, filtered messages received from the server;

10       FIGURE 3 illustrates a filtering criteria selection dialog window that permits a user to specify filtering criteria to be applied by the network management server;

FIGURE 4 illustrates a rearrangement dialog window that permits a user to order the display of fields on the console for each received message;

15       FIGURE 5 is a flowchart illustrating a method for establishing and updating filtering criteria for consoles;

FIGURE 6 is a flowchart illustrating a method for processing and communicating a network management message to a network element and parsing and filtering the message for display on selected consoles; and

20       FIGURE 7 is a flowchart illustrating a method for processing a received network management message including parsing and filtering the message for communication to selected consoles.

DETAILED DESCRIPTION OF THE INVENTION

FIGURE 1 illustrates a communication system, indicated generally at 10, that includes a network management server 12, network management clients 14, and network elements 16. In general, clients 14 issue network management commands to server 12 for communication to network elements 16, and clients 14 display network management messages received from server 12. Server 12 translates and formats commands from clients 14, communicates these commands to network elements 16, receives various messages from network elements 16, and communicates these messages in various forms to selected clients 14. More specifically, server 12 includes elements for filtering network management messages and communicating each message to display elements on appropriate clients 14 based on filtering criteria.

Server 12 represents hardware, including any appropriate software and/or logic, providing an interface between clients 14 and network elements 16. Similarly, clients 14 represent hardware, including appropriate software and/or logic, for interfacing with users to support network management of network elements 16. These network elements 16 represent local and remote network equipment, including software and/or logic, capable of receiving and responding to network management messages and generating autonomous network management messages. For example, network elements 16 may include communications cards and/or components of cards installed in communication equipment racks. Thus, server 12 provides an interface for clients 14 to issue commands to network elements 16 and receive responses, acknowledgements, and other types of messages from network elements 16. Network management messages include any communications with network elements 16 for creating, updating, configuring, obtaining status, monitoring operation, or performing other suitable functions. Moreover, server 12 and network elements 16 may communicate network management messages using control channels, communication channels, and/or other suitable connections.

To facilitate interactions with users and with server 12, client 14 includes a graphical user interface (GUI) 18, a common object request broker architecture (CORBA) interface 20, and one or more consoles 22. Using GUI 18, client 14 graphically presents on a display information on various network elements 16 managed by client 14. For example, GUI 18 may graphically depict a

communications equipment rack and cards mounted within the rack, along with other information, such as status and configuration information and available operations for the displayed equipment. GUI 18 also allows users to specify commands for communication to network elements 16. For example, using "point and click" techniques, a user may specify a cross-connect command between network elements 16 graphically depicted by GUI 18. GUI 18 communicates these commands using CORBA interface 20 to server 12. GUI 18 also receives responses, acknowledgements, and updates from server 12 through CORBA interface 20 and updates its graphical depictions based upon the information received.

Client 14 also includes one or more consoles 22, which display real-time and/or other suitable network management messages in with information from the native communication protocol used by server 12 to communicate with network elements 16. That is, while client 14 may communicate with server 12 using any appropriate protocol, such as CORBA, server 12 may communicate with network elements 16 using a disparate protocol, such as transaction language 1 (TL1) network management protocol. Thus, console 22 displays information in the form used for the native communications between server 12 and network elements 16. For example, console 22 may display all of the fields or selected fields of TL1 messages reported from server 12. Client 14 may display console 22 as discrete windows of a shared display and/or using separate displays.

Therefore, consoles 22 provide displays for presenting network management messages received from server 12. Because server 12 reports these messages to consoles 22 on a real-time basis, consoles 22, according to a particular embodiment, each provide a buffer for storing previously received messages. For example, console 22 may provide a scroll bar for scrolling among the previously received one thousand network management messages. However, the size of the buffer and the number of stored previously received network management messages may be set according to any appropriate system requirements/configurations.

Each console 22 receives network management messages for display from server 12 based on filtering criteria established for the particular console 22, with the filtering criteria potentially including a user type for console 22 and filter options selected by a user of console 22. Thus each console 22 has associated filtering criteria

that may be unique or identical to other consoles 22. For example, a user may establish one console 22 for receiving all messages of a particular message type. The user may also establish other consoles 22 for receiving network management messages based upon the same or different filtering criteria. Thus, a user of client 14  
5 may establish one or more consoles 22 for displaying network management messages according to any selected filtering criteria. In setting up or using consoles 22, users specify particular filtering options, which consoles 22 then communicate using CORBA interface 20 to server 12. Server 12 uses the filtering options, along with a user type associated with console 22, to determine filtering criteria for the associated  
10 console 22. Server 12 then uses the established filtering criteria for all consoles 22 to route each network management message for display on appropriate consoles 22. The description below with respect to FIGURES 2-4 provides greater detail of a particular embodiment for consoles 22.

To provide a readily defined interface between elements of client 14 and  
15 server 12, client 14 uses CORBA interface 20 to facilitate communication. For communications to server 12, CORBA interface 20 receives information from GUI 18 and/or consoles 22, formats each particular communication from GUI 18 or console 22 into a CORBA message, and communicates the CORBA message to the appropriate element of server 12. In addition, CORBA interface 20 receives CORBA  
20 messages from elements of server 12 and communicates information from these messages in an appropriate form to GUI 18 and consoles 22. The use of a defined standard, such as CORBA, for communications between clients 14 and server 12, permits effective, efficient implementation of client 14. Moreover, the use of CORBA messages abstracts the specific underlying communication protocols used for  
25 network management messages between server 12 and network elements 16. For example, server 12 may communicate with network elements 16 using a TL1 protocol. Yet, by providing a generic CORBA interface, client 14 allows for integration with systems using any appropriate network management protocols. However, while the embodiment illustrated and the accompanying description focuses  
30 on the use of CORBA messages for communications between client 14 and server 12, system 10 contemplates client 14 and server 12 communicating using any number and suitable type of communications protocols.



According to particular embodiments, server 12 communicates with network elements 16 using the TL1 management protocol. The TL1 protocol implements messaging using human readable, American Standard Code for Information Interchange (ASCII) text messages to send commands and receive responses, acknowledgements and autonomous messages. For this embodiment and other embodiments using human readable messaging between server 12 and network elements 16, consoles 22 display the actual messages communicated between server 12 and network elements 16 in a parsed and filtered format. Thus, consoles 22 display the content of network management messages satisfying established filtering criteria. Therefore, while GUI 18 provides a user-friendly interface that abstracts network management functions from the underlying network management protocol in use, consoles 22 display information from the actual network management messages communicated between server 12 and network elements 16. Moreover, for each different management protocol used for communications between server 12 and network elements 16, clients 14 may have one or more consoles 22 corresponding to each protocol.

To interface between clients 14 and network elements 16, server 12 includes an application server 24 and a communication server 26. Server 12 also includes a security server 28 that provides information for limiting access of various clients 14 to network messages, and server 12 includes a network management messages log 30 that stores all network management messages transmitted and received by server 12. Working together, these elements permit server 12 to act as an interface between clients 14 and network elements 16 and to provide logging and reporting of communications with network elements 16.

Application server 24 communicates through CORBA interface 20 with GUI 18 to receive commands generated by users and to update the information displayed by GUI 18. In general, application server 24 acts as a gatekeeper, allowing only valid commands from clients 14, while also ensuring that GUI's 18 on clients 14 remain appropriately updated with respect to the condition of network elements 16. To aid in validation of commands received from GUI's 18, application server 24 includes a management information base (MIB) 32 that maintains state information detailing the current status and configuration of network elements 16. Using this information,

application server 24 determines the validity of commands received from clients 14. For example, given a current configuration for network element 16, application server 24 may determine whether a command received from GUI 18 requests an appropriate operation. Application server 24 passes valid commands on to communication server 26 and, for invalid commands, application server 24 denies the request from client 14. According to particular embodiments, application server 24 communicates with communication server 26 using CORBA messages. Thus, for valid commands, application server 24 passes on the CORBA message received from GUI 18 without alterations. However, system 10 contemplates application server 24 and communication server 26 communicating using any suitable protocols, and application server 24 performing any appropriate modifications or translations before forwarding commands from GUI's 18.

Application server 24 also uses the information maintained in MIB 32 to process responses, acknowledgements, and autonomous messages received from communication server 26. For example, upon receiving a response to a command issued by client 14, application server 24 accesses and updates MIB 32 based on the response and determines clients 14 affected by the message from communication server 26. For example, upon receiving a response from communication server 26, application server 24 accesses MIB 32 to determine client 14 that issued the command leading to the response. Application server 24 then communicates the response and/or other appropriate information from MIB 32 to that client 14. In addition, application server 24 may also access MIB 32 to determine other clients 14 affected by the response. For example, multiple clients 14 may manage or monitor a particular network element 16. Thus, information from one network element 16 may require updates from application server 24 to multiple clients 14 actively viewing or using information for element 16. Therefore, application server 24 acts as a gatekeeper to ensure validity of requests received from clients 14 and as a conduit to ensure that messages received through communication server 26 from network elements 16 pass to the appropriate clients 14.

Within server 12, communication server 26 provides an interface between application server 24 and network elements 16. Thus, for the embodiment illustrated, communication server 26 translates between CORBA messages communicated with

application server 24 and the underlying network management protocol, such as TL1, used for communications with network elements 16. For example, upon receiving a CORBA message from application server 24 that includes a request from a particular client 14 to issue a command to network element 16, communication server 26  
5 translates the CORBA message into the appropriate TL1 format and communicates the TL1 command to network element 16. To perform this translation, communication server 26 determines the fields for the TL1 command based on information in the received CORBA message. Additionally, communication server 26 may generate other fields, such as a message identifier, required by the TL1  
10 protocol but not included in the CORBA message. Communication server 26 then formats the fields determined from the CORBA message along with the additional generated fields into a TL1 command. For example, communication server 26 may appropriately order the fields and generate an ASCII text string with the fields delimited by commas. Communication server 26 communicates this TL1 command  
15 to the appropriate network element 16. However, because communication server 26 can support other or multiple protocols, communication server 26 may include various translators for each protocol used for communications with clients 14 and/or network elements 16.

According to particular embodiments, the TL1 command communicated to  
20 network element 16 does not uniquely identify client 14 that initiated the command. Similarly, the response and/or acknowledgements received in response to the command will not identify client 14. However, the TL1 command may include a message identifier, such as a "CTAG" (correlation tag) field that, in conjunction with the session established with network element 16, uniquely identifies the command.  
25 Thus, to permit the association of received responses with responsible clients 14, communication server 26 maintains outstanding command information 34. Outstanding command information 34 stores information on commands issued to network elements 16 yet still awaiting responses. This information includes data for relating each received response from a particular network element 16 to client 14 that  
30 issued the command instigating the response. Thus, to permit association of received responses to the issued TL1 command with appropriate clients 14, communication server 26 generates an entry in outstanding command information 34 associating the

identity of client 14 with the CTAG and session for the command. In addition, because communication server 26 can support other or multiple protocols, communication server 26 may include multiple parsers for handling various protocols.

Communication server 26 also handles the receipt of messages from network elements 16. The messages received from network elements 16 may include, for example, acknowledgement of received commands, responses to commands, unsolicited/autonomous messages, and other appropriate types of messages. Upon receiving a network management message from a selected network element 16, communication server 26 parses the message into its constituent fields. For example, a TL1 message may include a comma delimited string of fields, which communication server 26 parses out into separate fields. By examining a message identifier field, communication server 26 determines whether the received message is associated with a command that was previously sent. For example, within a TL1 message, a CTAG identifier will match up to the CTAG identifier for a command issued from communication server 26. If, however, the TL1 message identifier includes an ATAG, it signifies that the message is an autonomous message.

For autonomous messages, communication server 26 formats the parsed fields from the received message into a CORBA message and forwards the CORBA message to application server 24. However, for messages responsive to previous commands, communication server 26 first accesses outstanding command information 34 to identify client 14 associated with the message. Then, using the identity of client 14 and the fields from the received message, communication server 26 translates the response into a CORBA message and communicates the CORBA message to application server 24 for forwarding to appropriate clients 14.

In addition to translating between the protocols used to communicate with application server 24 and network elements 16, communication server 26 also provides reporting and logging of the information from some or all network management messages. Thus, communication server 26 supports logging and reporting of network management messages transmitted to and received from network elements 16. Moreover, communication server 26 supports logging of this information in the native protocol used for communications with network elements 16. When using a human readable protocol, such as TL1, this provides for the

logging and reporting of the actual values from the fields of network management messages.

To provide the logging and reporting functionalities, communication server 26 includes log agent 36. In general, log agent 36 provides logging of network management messages communicated by communication server 26 with network elements 16, as well as reporting of these messages to particular consoles 22 based on filtering criteria established for each console 22. To support the logging and reporting of log agent 36, communication server 26 passes a copy of each network management message communicated with network elements 16 to log agent 36 in a parsed form.

Log agent 36 stores each of these messages into log 30. For example, upon receiving a parsed message from communication server 26, log agent 36 generates an entry in log 30 with each separate field of the message maintained in a separate column of the entry. Thus, by operating on parsed messages, log agent 36 may quickly and effectively store each message into log 30. This permits real-time storage of messages in a format that may be easily accessed and manipulated as necessary. Moreover, because communication server 26 passes all network management messages, both transmitted and received, to log agent 36, log 30 includes a record of all network management messages communicated with network elements 16 by server 12.

In addition to logging all messages in log 30, log agent 36 also reports messages to consoles 22 based on filtering criteria established for each console 22. To enable this filtering process, log agent 36 includes filtering information 38, which maintains filtering criteria for each console 22. For example, filtering information 38 may store a filter table that includes entries for each console 22 indicating a console identifier in various filtering criteria for determining whether to communicate messages to this particular console 22. These filtering criteria include parameters established by console 22 to filter out only desired messages to receive. Thus filtering criteria may include specific values for particular fields in messages to be delivered to console 22 by log agent 36. For example, a particular console 22 may select to receive only messages from a selected network element 16. In addition to filtering criteria established by consoles 22, filtering information 38 for each console 22 also includes user information for limiting the distribution of messages to appropriate

consoles 22. This user information implements security to prevent unauthorized users from establishing consoles 22 to receive messages from unauthorized network elements 16. For example, a general user may have access only to messages responsive to commands issued by that user. Similarly, a super-user may have access to all messages communicated with network elements 16.

To establish user access levels in filtering information 38, log agent 36 communicates with security server 28. For example, when setting up filtering information 38 for a new console 22, log agent 36 may determine a user identifier associated with client 14 or the user of client 14, and, using this identifier, requests an access from security server 28. Security server 28 accesses user information 40 to determine the user type and/or access level for the identified user and returns this information to log agent 36. For example, system 10 may include various user levels corresponding to different levels of access to network management messages, such as a super-user having access to all messages and other levels of users, each having various restrictions on access to network management messages. Therefore, using the access level information from security server 28 in conjunction with various filtering options received from console 22, log agent 36 establishes filtering information 38 for use in selecting particular messages to communicate to console 22. Thus, for each message received in parsed form from communication server 26, log agent 36 stores the message in log 30 and communicates the parsed message to any number of consoles 22 upon identifying matches in filtering information 38.

While the embodiments illustrated for server 12 and clients 14 include specific logical elements coupled and communicating in a particular fashion, system 10 contemplates server 12 and clients 14 implementing their various functions using any suitable combination and arrangement of hardware, software, and other appropriate logic. Thus, while these embodiments illustrate a particular distribution of functionalities among various logical elements, system 10 contemplates any suitable distribution, separation or combination of functionalities, so long as the elements provide for the parsing of network management messages and the filtering of these parsed messages for communication to one or more client consoles. Moreover, while the embodiment illustrates server 12 separate from clients 14, system 10 contemplates any suitable combination or separation of server 12 and clients 14 on one or more

computing devices. Thus, for example, server 12 and clients 14 may represent separate processes executing on a single computing device or on different computing devices.

FIGURE 2 is a screen shot illustrating an exemplary console 22 displayed by client 14. As demonstrated by this exemplary embodiment, console 22 may use a graphical "window" interface to display network management messages received from log agent 36 and to provide various options to users. In the embodiment illustrated, console 22 includes a display frame 50 and a tool bar 52. Within display frame 50, console 20 displays, in chronological order, messages received from log agent 36. Thus, display frame 50 provides a real-time log of messages filtered according to the particular filtering criteria established for this console 22. As previously discussed, console 22 may include a buffer that stores, for example, the one thousand most recently received messages from log agent 36. To access this buffer, console 22 provides a scroll bar 54 that allows a user to scroll to buffered messages. Moreover, using console 22, a user may recall and view previously received messages, such as messages stored in log 30, and view these messages based on established filtering options.

Tool bar 52 allows users of console 22 to access various management and configuration functions of console 22. In the embodiment illustrated, tool bar 52 provides traditional functions of "save" and "print." As with typical applications, these functions in tool bar 52 provide for saving the buffer of console 22 into a file and printing of the buffer of console 22. Toolbar 52 also provides access to various flow control options for network management messages received from server 12. To stop and subsequently resume receiving messages from log agent 36, tool bar 52 includes "stop" and "update" buttons. When receiving messages from log agent 36, selecting the stop button, causes console 22 to discontinue displaying received messages and to discard any new messages received from log agent 36. Thus, console 22 does not buffer any messages from log agent 36 received after selecting the stop button. To resume storing of received messages from log agent 36 in the buffer and the display of these messages in display frame 50, a user may select the update button. To temporarily pause the display of received messages in display frame 50 while maintaining received messages in the buffer, tool bar 52 includes a "pause" button.

By selecting the pause option, a user halts the display of new messages received from log agent 36. However, while paused, console 22 continues storing newly received messages in the buffer. Thus, upon selecting the update button, console 22 will display the messages received from log agent 36 while in the pause state. To clear the contents of the buffer maintained by console 22 and the messages in display frame 50, tool bar 52 includes a "clear all" button.

To configure the types of messages to receive from log agent 36 and the particular order in which those messages are displayed in display frame 50, tool bar 52 includes a "rearrange" button and a "filter" button. Upon selecting the rearrange button, console 22 launches a separate window that provides a user various options for arranging the order of fields in messages displayed in display frame 50. On selecting the filter button, console 22 launches a separate window that permits a user to specify criteria for use by log agent 36 in selecting messages to communicate to console 22. The separate windows are discussed below in more detail with respect to FIGURES 3 and 4. However, while the embodiment illustrated for console 22 includes specific buttons and frames arranged in a particular manner, system 10 contemplates console 22 having any appropriate frames, buttons, and functionalities for displaying network management messages received from log agent 36.

FIGURE 3 illustrates an exemplary filtering options dialog window 60 used by console 22 to receive filtering options from a user. In the embodiment illustrated, the dialog window permits a user to select to receive particular message types and to filter for messages from particular network elements 16. For example, by selecting from the message types in a message type selection window 62, a user may determine the type of messages filtered by log agent 36 for communication to console 22. Similarly, using the options in a network element selection window 64, a user may specify values to match against identifiers associated with network elements 16 such that log agent 36 forwards only messages associated with particular network elements 16.

However, while the embodiment illustrated contains specific options arranged in a particular format, system 10 contemplates console 22 presenting any suitable interface for a user to identify filtering criteria for use by log agent 36. Moreover, while the embodiment illustrated provides only limited options for filtering messages,



system 10 contemplates console 22 permitting users to specify any suitable filtering options and values for comparing against information in network management messages processed by communication server 26. Thus, users may specify any number of values and fields for filtering message, with the types of values and fields depending upon the format and protocol for network management messages processed by communication server 26.

FIGURE 4 illustrates a rearrangement dialog window 70 for use by a user in arranging the order of presentation of fields for each network management message displayed in display frame 50. Within an attribute list frame 72, window 70 displays the fields available to display for each message received from log agent 36. Within a selected attributes frame 74, window 70 displays those fields from received messages that will be displayed by display frame 50. By moving attributes between these frames 72 and 74, a user may specify those fields from each message to display. Thus, a user may select to view some or all of the fields for messages received from log agent 36.

In addition, a user may arrange the order in which fields of received messages are displayed in display frame 50. The order of fields in selected attributes frame 74, from top to bottom, corresponds to the order in which fields from received messages are displayed, from left to right, in display frame 50. Thus, to change the order in which fields are displayed, a user selects one of the fields in selected attributes frame 74 and, using an up button 76 or a down button 78, rearranges the ordering of the selected fields. Thus, using window 70, a user of console 22 defines the fields viewed for each message received from log agent 36 as well as the ordering of those fields in display frame 50. However, as with the previous exemplary embodiments, system 10 contemplates console 22 providing any suitable options and interfaces for selecting options for the display and arrangement of various fields of network management messages received from log agent 36.

FIGURE 5 is a flowchart illustrating the interaction between console 22 and log agent 36 for setting up and modifying filter information 38 in addition to the operation of console 22 in displaying received network management messages. Console 22 is initiated at step 100 and communicates selected filter options to log agent 36 at step 102. For example, at initiation, console 22 may communicate a set of

default filter options or may access profiles or other information to determine selected filter options for a particular user.

Log agent 36 receives the filter options from console 22 at step 104 and determines whether the received filter options represent a change to existing filter information 38 at step 106. For example, based upon a console identifier communicated by console 22 along with the request for selected filter options, log agent 36 may access filter information 38 to determine whether an entry for this console 22 has previously been established. If so, log agent 36 updates filter information 38 at step 108, and responds to console 22 as completed at step 114. However, if log agent 36 determines that the selected filter options communicated from console 22 are not yet entered into filter information 38, log agent 36 accesses security server 28 to determine access information for console 22. As previously discussed, log agent 36 may receive any suitable information received from security server 28 to determine an appropriate user type or access level for including in filter information 38. Thus, upon receiving user access information from security server 28, log agent 36 generates an entry in filter information 38 for console 22. This entry is based on filter options received from console 22 and security information received from security server 28. Upon generating the entry in filter information 38, log agent 36 responds as completed at step 114. Thus, steps 104 through 114 detail the exemplary operation of log agent 36 in response to requests from consoles 22 to create or update filter information 38.

During operation, console 22 provides users an option to alter filter options. Thus, in this flowchart, console 22 determines whether a user has changed filter options at step 118. If so, console 22 once again communicates the selected filter options to log agent 36 at step 102. However, given no change in the filter options, console 22 determines whether a user has changed display options at step 120. The display options represent the fields selected for display and the ordering of these fields as selected by a user through window 70. Given a change in the display options, console 22 updates the display options such that subsequently received messages are displayed according to the selected options. Given no change in the display options, console 22 skips step 122. At step 124, console 22 determines whether a network management message has been received from log agent 36. If so,

console 22 displays the message according to the selected display options at step 126. Otherwise, console 22 continues monitoring for changes in filtering options, display options, or for received messages. Thus, at steps 118 through 126, console 22 provides for the receipt and display of network management messages from log agent 5 36 and for user initiated changes in filter options and display options.

FIGURE 6 is a flowchart illustrating a method for processing commands generated by GUI 18 that are communicated through various elements of client 14 and server 12 to network element 16. Using GUI 18, a user initiates a command, such as a cross-connect command, at step 150. Based upon the command initiated, 10 CORBA interface 20 generates a CORBA message encoding the command at step 152 and communicates the CORBA message to application server 24 at step 154.

Application server 24 receives the CORBA message from client 14 at step 155 and determines whether this is a valid CORBA message at step 156. For example, application server 24 may access MIB 32 to determine state information for network 15 element 16 specified in the CORBA message. Based upon the command, the state of network element 16, the identity of client 14, and any other suitable information, application server 24 determines the validity of the message. If the message is invalid, application server 24 denies the request at step 158 and completes processing for this command. However, upon determining that the message is valid, application 20 server 24 communicates the CORBA message to communication server 26 at step 160.

Communication server 26 receives the CORBA message from application server 24 at step 162. Communication server 26 translates the CORBA message to generate a TL1 message at step 164 and communicates the TL1 message to the 25 appropriate network element 16 at step 166. In addition, communication server 26 stores message information for this TL1 message in outstanding command information 34 at step 168. As previously discussed, this information permits communication server 26 to associate future responses to this TL1 message with the particular client 14 that initiated the message. In addition to communicating the TL1 30 message to the appropriate network element 16 and generating an entry in outstanding command information 34, communication server 26 also communicates the parsed fields of the TL1 message to log agent 36 at step 170. As previously discussed,

because communication server 26 generates the TL1 message based on information contained in the CORBA message, communication server 26 has the fields of the TL1 message in parsed form for communication to log agent 36.

Log agent 36 receives the parsed TL1 message from communication server 26 at step 172, and stores the parsed TL1 message in log 30 at step 174. Log agent 36 also matches the parsed fields of the message against filter information 38 to determine appropriate consoles 22 to receive the message. To perform this matching, log agent 36 determines whether unchecked entries in filter information 38 remain at step 176. This determines whether all entries for consoles 22 in filter information 38 have been compared against the message. If no unchecked entries remain, processing for this message is complete. However, if unchecked entries remain, log agent 36 selects an unchecked entry from filter information 38 at step 178 and determines whether the parsed TL1 message satisfies the criteria established for that entry at step 180. If not, log agent 36 continues checking the remaining entries in filter information 38. However, upon determining that the fields of the TL1 message satisfy the criteria for an entry, log agent 36 communicates the parsed TL1 message to the associated console 22 at step 182. Therefore, at steps 176-182, log agent 36 determines selected consoles 22 with filtering criteria matching the fields of the TL1 message and communicate the parsed TL1 message to those consoles 22.

FIGURE 7 illustrates a method for processing TL1 messages received from network element 16. Communication server 26 receives a TL1 message from network element 16 at step 200 and parses the TL1 message at step 202. Communication server 26 determines whether this is an autonomous message at step 204. If not, the message is in response to an earlier communicated command. Thus, communication server 26 accesses outstanding command information 34 to determine an associated client 14 at step 206. After determining the associated client 14 or upon determining that this was an autonomous message, communication server 26 initiates two processes, one to log and report the TL1 message and one to communicate the response to appropriate clients 14.

Thus, to initiate logging and reporting, communication server 26 communicates the parsed TL1 message to log agent 36 at step 208, and log agent 36 receives the parsed TL1 message from communication server 26 at step 210. Log

agent 36 stores the parsed TL1 message in log 30 at step 212. In addition, for reporting of the message to appropriate clients 14, log agent 36 determines whether unchecked entries in filter information 38 remain at step 214. This determines whether all entries for consoles 22 in filter information 38 have been compared  
5 against the message. If no unchecked entries remain, processing for this message is complete. However, if unchecked entries remain, log agent 36 selects an unchecked entry from filter information 38 at step 216 and determines whether the parsed TL1 message satisfies the criteria established for that entry at step 218. If not, log agent 36 continues checking the remaining entries in filter information 38. However, upon  
10 determining that the fields of the TL1 message satisfy the criteria for an entry, log agent 36 communicates the parsed TL1 message to the associated console 22 at step 220.

In addition to the logging and reporting, communication server 26 also provides for the delivery of the received message to the appropriate client 14 or  
15 clients 14. Thus, communication server 26 formats the parsed TL1 message into a CORBA message at step 222. For example, using the fields parsed from the TL1 message along with the client identifier determined from accessing outstanding command information 34, communication server 26 may generate a CORBA message. Communication server 26 communicates the CORBA message to  
20 application server 24 at step 224.

Application server 24 receives the CORBA message from communication server 26 at step 226. Based on the information contained in the CORBA message, application server 24 updates information in MIB 32 to reflect the current state and configuration for network element 16 associated with the CORBA message.  
25 Application server 24 performs this update at step 228. Application server 24 also communicates the CORBA message to affected clients 14 at step 230. For example, application server 24 may communicate the CORBA message to the client identified in the CORBA message. Moreover, application server 24 may access MIB 32 to determine other clients 14 currently managing or monitoring the particular network  
30 element 16 or elements 16 affected by the CORBA message and communicate copies of the CORBA message to each of these clients 14. Thus, application server 24 may initiate the update of GUT's 18 for all appropriate clients 14.

While the preceding flowcharts illustrate exemplary methods of operation, system 10 contemplates elements of server 12 and clients 14 using any suitable techniques for communicating various network management messages with network elements 16 and parsing and filtering these messages for display on consoles 22.

5 Thus, while these flowcharts illustrate specific steps taking place in particular orders, system 10 contemplates elements performing many of the steps in these flowcharts simultaneously and/or in different orders than as shown. Moreover, as previously discussed, system 10 also contemplates any suitable distribution or separation of functionalities between various elements in server 12 and clients 14. Thus, while  
10 many of the steps in these flowcharts are described as taking place in particular elements, system 10 contemplates any suitable distribution, separation or combination of functionalities in particular elements. Furthermore, system 10 contemplates server 12 and clients 14 using methods with additional steps, fewer steps, and/or different steps, so long as the methods remain appropriate for the communication of network  
15 management messages with network elements 16 and the parsing and filtering of these messages for display on selected consoles.

Although the present invention has been described in several embodiments, a myriad of changes and modifications may be suggested to one skilled in the art, and it is intended that the present invention encompasses such changes and modifications as  
20 followed in the scope of the present appended claims.